DOCUMENT RESUME

ED 139 938 CE 010 956

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TITLE Electronics Technology. Performance Objectives. Basic Course.
INSTITUTION Duval County School Board, Jacksonville, Fla.
PUB DATE Jul 73
NOTE 40p.; For a related document see CE 010 954

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Behavioral Objectives; *Criterion Referenced Tests; Electric Circuits; Electricity; Electronic Equipment; *Electronics; Electronic Technicians; Secondary Education; Shop Curriculum; Technical Education; Trade and Industrial Education

ABSTRACT

Several intermediate performance objectives and corresponding criterion measures are listed for each of 20 terminal objectives for a basic electronics technology course. The materials were developed for a two-semester course (2 hours daily) designed to include instruction in basic electricity and electronic fundamentals, and to develop skills and knowledges in AC and DC Theory, electrical safety experiences, hand tool usage and related electrical and electrical fundamental laboratory experiences. Titles of the 20 terminal objectives are Introduction to Course; Electrical Safety; Electrical Mathematics Review; Basic Physics for Electronics; Magnetism; Electric Circuits; Electric Measuring Devices; Resistance, Ohms Law and Circuits; Hand Tools and Soldering; Electrical and Electronic Diagrams; Meters; Alternating Current, Inductors, Transformers; Capacitance; Mathematics for AC Circuits; Inductive Reactance and Impedance; Capacitive Reactance and Impedance; AC Circuit Analysis; Series Resonant Circuit; and Electronics Technician Occupation Analysis. (This manual and 54 others were developed for various secondary level vocational courses using the System Approach for Education (SAFE) guidelines.) (HD)

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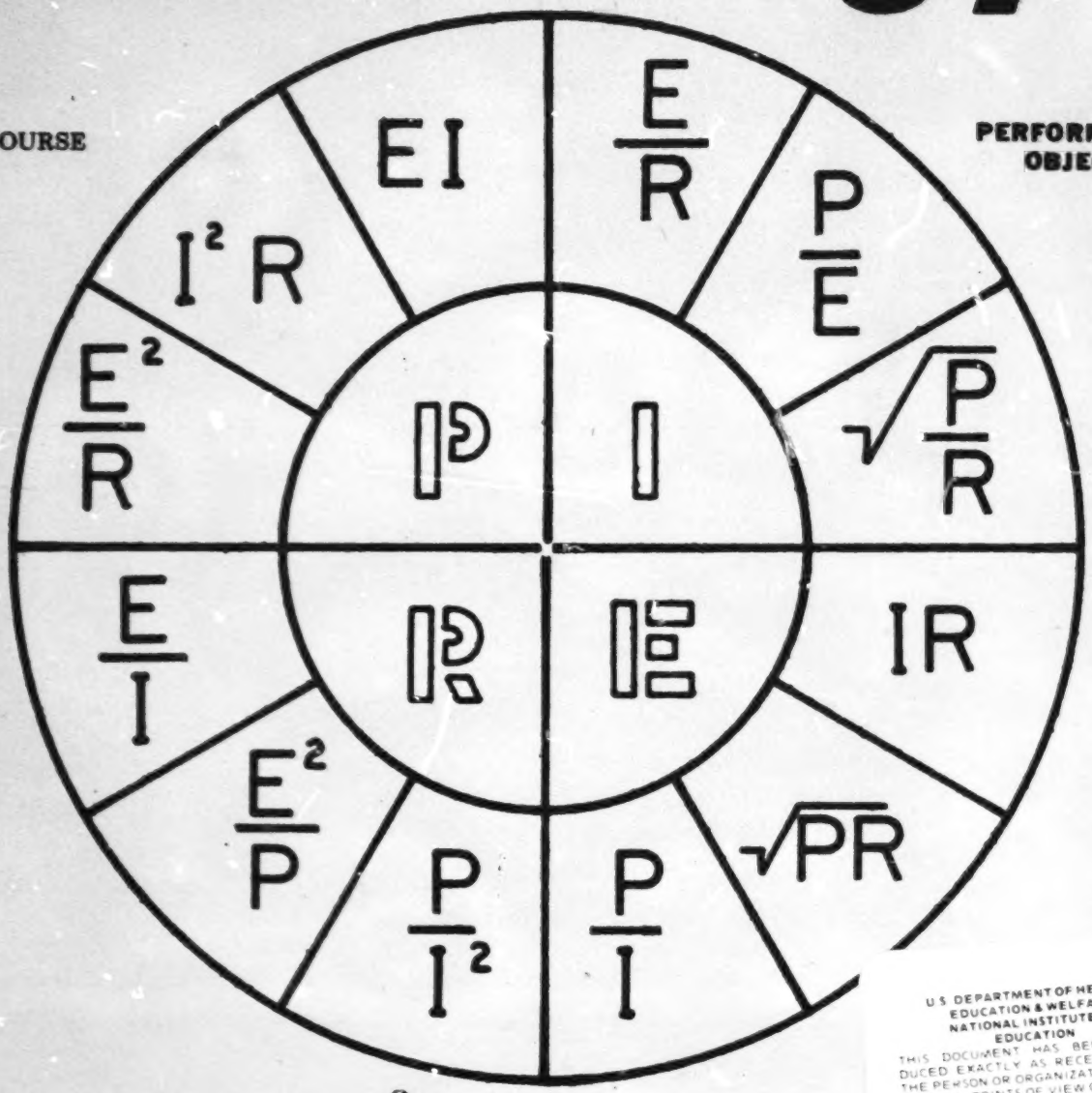
electronics technology

BASIC COURSE

PERFORMANCE OBJECTIVES



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Duval County Public Schools

July, 1973

ELECTRONICS TECHNOLOGY - BASIC

Accreditation No. 8028 - P

Length of Course: 2 Semesters

Time Block: 2 hours daily

COURSE DESCRIPTION

This course meets 2 hours per day and includes instruction in Basic Electricity and Electronic Fundamentals. Develops skills and knowledges in AC and DC Theory, electrical safety experiences, hand tool usage and includes related Electrical and Electrical Fundamental Laboratory experiences.

ACKNOWLEDGEMENTS

This manual was developed using System Approach For Education (SAFE) Guidelines.

Appreciation and recognition are extended to the following educators who have assisted in the preparation of this manual:

Writer: Guy Campbell, Instructor

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Bill Sheppard, Curriculum Specialist

Cover Design: Mr. Fred Westerfeld, Instructor

Typist: Miss Catherine Boatright

SYLLABUS OF TERMINAL PERFORMANCE OBJECTIVES

for

ELECTRONICS TECHNOLOGY - BASIC

1.0 Introduction to Course

2.0 Electrical Safety

3.0 Electrical Mathematics Review

4.0 Basic Physics for Electronics

5.0 Magnetism

6.0 Electric Circuits

7.0 Electric Measuring Devices

8.0 Resistance, Ohms Law and Circuits

9.0 Hand Tools & Soldering

10.0 Electrical and Electronic Diagrams

11.0 Meters

12.0 Alternating Current, Inductors, Transformers

13.0 Capacitance

14.0 Mathematics for AC Circuits

15.0 Inductive Reactance and Impedance

16.0 Capacitive Reactance and Impedance

17.0 AC Circuit Analysis

18.0 Series Resonant Circuit

19.0 Parallel Resonant Circuit

20.0 Electronics Technician Occupation Analysis

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 1.0 Introduction to Course

Given introductory information regarding course operating procedures the learner will state the scope of the course and its objectives, rules for class starting and ending time, grading procedures conduct in class and lab, equipment use and inventory and club organizations. The criterion of success shall be completion of each IPO at its respective criterion.

O.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.1	The learner will state the purpose of the course, the starting and ending times for the class and will list 10 subject areas to be covered in this course.	1.1	a.State the purpose of this course b.State the starting and ending times for this class. c.List 10 subject areas to be covered in this course.
.2	The learner will state the percentage for each given area of responsibility as they affect the student's final grade.	1.2	Write the percentage that each of the following will weigh upon your final grade: written work & notebook_____ experiments_____ tests_____ project work_____
.3	The learner will describe the procedure for making up work missed and will state 5 rules governing conduct in class and lab.	1.3	a.Describe the procedure for making up work missed. b.State 5 rules of conduct for classroom and laboratory.
	The learner will state 10 rules concerning the use of shop equipment.	1.4	Write 10 rules to be followed when using shop equipment.
.5	Given instruction in inventory systems the student will describe the shop inventory system and the means for maintenance of a perpetual inventory.	1.5	a.Describe the inventory system used in this shop. b.Explain how a perpetual inventory can be maintained.
.6	The learner will demonstrate his knowledge of student organizations available to him by answering 5 of 6 test questions.	1.6	a. What is VICA? b. What are the goals and objectives of VICA? c. List three activities that local VICA members participate in. d. How is VICA organized? e. How can you benefit from VICA? f. What do you have to do to join VICA?

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 2.0 Electrical Safety

Given information regarding electrical safety, the learner will describe and/or demonstrate safety rules, artificial respiration, burn treatment, an electrical ground, reason for electrical ground and classes of fires and extinguishers for each.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
2.1	The learner will state 5 general safety rules for the Radio & T. V. Laboratory.	2.1	State 5 safety rules for the Radio & T. V. Laboratory.
2.2	The learner will define the term "safety consciousness"	2.2	Define the term "safety consciousness"
2.3	The learner will state 5 steps used in treating electrical shock victims.	2.3	Write 5 steps necessary in treating electrical shock victims.
2.4	The learner will demonstrate the correct method of applying artificial respiration.	2.4	Demonstrate the correct method of applying artificial respiration.
2.5	The learner will identify the correct definition of an electrical ground.	2.5	Select the correct definition of an electrical ground: a. Protection for humans b. Connection of the neutral wire to earth. c. Connection of a wire to earth.
2.6	The learner will state two reasons for having an electrical ground.	2.6	State two reasons for having an electrical ground.
2.7	The learner will state the four classes of fires and name a type of fire extinguisher for each.	2.7	State the 4 classes of fires and name a type of fire extinguisher for each class.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 3.0

Electrical Math Review

INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
The learner will with a minimum of 75% accuracy, solve given math problems involving the addition, subtraction, multiplication and division of whole numbers.	3.1	Solve: (a) Add 4 + 18 + 36 + 7 (b) Subtract 371 from 481 (c) Multiply - 8 x 507 (d) Divide - 180 by 6
Given 4 problems involving fractions the learner will solve 3 of them correctly.	3.2	Solve: (a) Add 3¼ + 2 1/8 + 118 3/16 (b) Subtract - 7 1/8 from 9 1/16 (c) Multiply - 2 5/16 x 1 3/8 (d) Divide - 18 1/4 by 3 1/8
Given 4 problems involving decimals the learner will correctly solve 3 of them.	3.3	Solve: (a) Add 4.2 + 3.1 + 87.53 (b) Subtract - 11.20 from 15.1 (c) Multiply - 3.27 x 21.05 (d) Divide - 17.68 by 3.15
Given 4 problems involving percentage the learner will correctly solve 3 of them.	3.4	Solve: (a) What percent of 90 is 30 (b) What is 15% of 120 (c) What is 1% of 27 (d) If 2% = 5 what is 1%
Given 4 problems involving square and square root, the learner will correctly solve 3 of them.	3.5	Solve: (a) Find the square root of 3,170 (b) Square 27 (c) What is the square root of 11.9 (d) The square root of 10½ is _____.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 3.0

Electrical Math Review

INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
Given 4 problems involving exponents the learner will correctly solve 3 of them.	3.6	Solve: (a) $10^2 + 10^2$ (b) What is 380 expressed in the power of 10 (c) Write this in long form, 1.8^2 (d) What is 11,700,000 expressed in the power of 10.
The learner will demonstrate his proficiency in the use of the slide rule by solving 3 of 4 given problem correctly using the slide rule.	3.7	Solve using slide rule: (a) Sq. root of 1,426 (b) 118 x 27 (c) 426 ÷ 3 (d) Sq. Root of 610

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 4.0 Basic Physics for Electronics

Given instruction in Basic Physics for Electronics, the learner will write a definition for each of the terms used in the structure of Matter and the production of electrical energy, state the laws of electrical charges and the methods of producing electrical energy, describe the effects that electricity can produce and state the requirements for producing current flow. The criterion of success shall be the completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
4.1	The learner will correctly define a minimum of 15 of 19 given terms associated with the structure of Matter.	4.1	Define the following terms: a. Matter b. Elements c. Compound d. Atom e. Molecule f. Proton g. Electron h. Neutron i. Atomic Number j. Valence shell k. Electron shell l. Conductor m. Insulator n. Semiconductor o. Static Elect. p. Dynamic Elect. q. Coulomb r. Volt s. Ampere
4.2	The learner will state the LAW of electrical charges.	4.2	State the law of Electrical charges.
4.3	The learner will lsit 4 out of 5 methods for producing electrical energy and describe the type of equipment that is used for producing each type of energy.	4.3	List the five methods used for producing electricity and describe the type of equipment used for producing each type of energy.
4.4	The learner will list 4 out of 5 effects that can be produced by electricity and describe the equipment used in each.	4.4	List the five effects that can be produced by electricity and describe the equipment used to produce each effect.
4.5	The learner will state the two requirements for current flow: a. Difference of potential b. Complete circuit	4.5	State the two requirements for current flow.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 5.0 Magnetism

Given the equipment, materials and instruction sheets on magnetism the learner will, define magnetic and electromagnetic terms, describe the laws and theories of magnetism, demonstrate the ability to use the left and right hand rules associated with conductors, coils, generators & motors, and define the terminology associated with the construction of motors and generators. The criterion of success shall be completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
5.1	Given a list of 14 terms associated with magnetism and electromagnetism the learner will define 9 of them.	5.1	Define the following magnetism and electromagnetic terms: a. Natural magnet b. Artificial magnet c. Retentivity d. Residual e. Temporary magnet f. Permanent magnet g. Magnetic Poles h. Saturation i. Magnetic field j. Electromagnetism k. Permeability l. Reluctance m. Ferromagnetic n. Magnetic Shielding
5.2	The learner will state the law of magnetism	5.2	State the law of magnetism.
5.3	The learner will describe the molecular theory of magnetism.	5.3	Describe the molecular theory of magnetism.
5.4	Given a variety of illustrations showing bar magnets, horseshoe magnets, poles attracting, and poles opposing, the learner will illustrate the magnetic lines of force for 75% of the problems.	5.4	Draw the lines of force to illustrate the magnetic field involving various types of magnets and pole positions for the problems given you by the instructor.
5.5	Given a variety of problems involving a current carrying straight conductor, the student will demonstrate the use of the left hand rule by determining the direction of current is known and vice versa.	5.5	Use the left hand rule for conductors to determine the direction of the magnetic field on the problem sheets given you.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 5.0 Magnetism

The learner will draw and describe magnetic fields; will define given magnetic terms and will draw and describe basic generator action.

INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
The learner will draw and describe the magnetic field around a straight conductor and around a coiled conductor.	5.6	Draw and describe the magnetic field around: (a) a straight conductor (b) a coiled conductor
Define the term "ampere-turn".	5.7	Define: "ampere-turn"
The learner will draw and describe basic generator action.	5.8	By the use of sketches and explanation show how a basic generator works.
Given 5 terms about electric generators and motors the learner will define 4 of them.	5.9	Define: (a) field poles (b) Armature (c) slip rings (d) Commutator (e) Brushes

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 6.0 Electric Circuits

The learner will define given electric circuit terms, will draw schematic symbols of given components and will draw circuit diagrams of given circuits, and will construct given circuits from diagrams.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.1	The learner will define 8 of 10 given electric circuit terms.	6.1	Define: (a) electric circuit (b) power source (c) conductor (d) load (e) protective device (f) controlling device (g) open circuit (h) short circuit (i) series connected (j) parallel connected
.2	Given a list of 10 electric circuit components the learner will draw the schematic symbol for 8 of them.	6.2	Draw the schematic symbols for each of the following: (a) battery (b) generator (c) conductors crossing, no connection (d) conductors crossing, connected (e) SPST switch (f) fuse (g) circuit breaker (h) variable resistor (i) lamp (j) resistor
.3	The learner will draw using schematic symbols the following circuits: (a) series (b) parallel (c) series-parallel	6.3	Use schematic symbols to draw examples of the following circuits: (a) series (b) parallel (c) series-parallel
.4	Given a schematic diagrams the learner will construct the circuits on the diagrams with 75% accuracy.	6.4	Construct the following circuits: (cont'd on next page)

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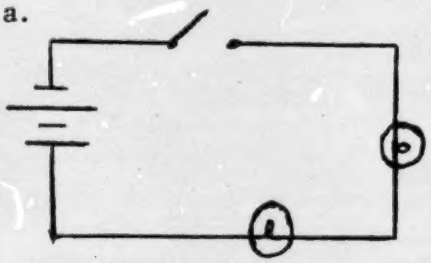
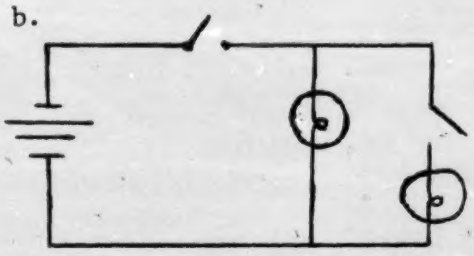
COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 6.0

Electric Circuits

INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
	6.4	a.  b. 

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 7.0

Electric Measuring Devices

The learner will explain the use of the D'Arsonval meter movement as an ammeter, voltmeter, and ohmmeter and given a circuit will demonstrate proficiency of 75% in using the multimeter to measure all electrical quantities in the circuit.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.1	The learner will demonstrate his knowledge of the basic D'Arsonval meter movement by explaining 4 of 5 given statements about the meter movement.	7.1	Explain each of the following statements as concerned with the basic D'Arsonval meter movement: (a) Construction (b) Effect when current is applied in correct direction. (c) Effect when current is applied in wrong direction. (d) Sensitivity
2	The learner will explain in writing with 75% accuracy how the D'Arsonval meter movement can be used as an ammeter, how the range of the meter can be increased and how an ammeter should be connected into circuit.	7.2	Explain the following: (a) How can the D'Arsonval meter movement be used as an ammeter. (b) How can you increase the range of an ammeter. (c) How should an ammeter connected into a circuit.
3	The learner will explain in writing with 75% accuracy how the D'Arsonval meter movement can be used to measure voltage, how to extend the range, and how a voltmeter should be hooked into a circuit.	7.3	Explain the following: (a) How can the D'Arsonval meter movement be used as a voltmeter. (b) How can you increase the range of a voltmeter. (c) How is a voltmeter hooked into a circuit.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 7.0

Electric Measuring Devices

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
7.4	The learner will explain in writing with 75% accuracy how the D'Arsonval meter movement can be used to measure resistance, why the ohmmeter uses a battery and how the ohmmeter should be connected to a circuit.	7.4	Explain the following: (a) How can the D'Arsonval meter movement be used as an ohmmeter. (b) Why does the ohmmeter need its own battery. (c) How is an ohmmeter connected to a circuit.
7.5	Given a simple electrical circuit the learner will connect and read all electrical measurements in the circuit with a multimeter with 75% accuracy.	7.5	Make all electrical measurements on the circuit provided using the multimeter. Record your answers on paper.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 8.0 Resistance, Ohms Law & Circuits

Given information sheets, equipment and materials dealing with Resistance, Ohms Law and Circuits the learner will define the terms associated with Resistance and Resistor, State the relationship between resistance and size and type of materials, draw the symbols for various types of resistors, demonstrate the ability to use the resistor color code, ohm's law and Kirchoffs laws, and solve problems involving series-parallel, bridge and voltage divider circuit,

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
1	Given a list of terms associated with resistance and resistors, the learner will define 12 of 15 of the following terms: a. Resistance b. Conductance c. Positive Temp. Coefficient d. Negative Temp. Coefficient e. Ohm f. Resistor g. Tolerance h. Current rating i. Fixed resistor j. Adjustable resistor k. Variable resistor l. Potentiometer m. Rheostat n. Linear resistance o. Non-linear resistance	8.1	Correctly define the following terms: a. Resistance b. Conductance c. Positive Temp. Coefficient d. Negative Temp. Coefficient e. Ohm f. Resistor g. Tolerance h. Currect rating i. Fixed resistor j. Adjustable resistor k. Variable resistor l. Potentiometer m. Rheostat n. Linear resistance o. Non-linear resistance
8.2	The learner will name the three best conductors of electricity.	8.2	Name the three best conductors of electricity.
8.3	The learner will name the material that is used as a standard for conductor resistance and state the reason why its used.	8.3	What material is used as a standard for conductor resistance? Why?
8.4	Given two questions the learner will explain the relationship between the physical size of a conductor and its resistance.	8.4	(a) If the cross-sectional area of a conductor is doubled, what happens to the resistance? (b) If the length of a conductor is doubled, what happens to the resistance?
8.5	Given a wire table, the learner will calculate the resistance of a specified size and length of copper wire.	8.5	What would be the resistance of 8 feet of No. 22 copper wire at 68°F.?

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 8.0 Resistors, Ohm's Law & Circuits

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.6	The learner will name the three types of resistor construction. a. Composition b. Wirewound c. Film	8.6	Name the types of resistors.
.7	The learner will draw the correct schematic symbol for a fixed resistor adjustable resistor and a variable resistor.	8.7	Draw the correct symbol for each of the following. a. Fixed resistor b. Adjustable resistor c. Variable resistor
8	Given a circuit problem the learner will, draw a schematic diagram of a circuit with a rheostat connected to control the current through a load.	8.8	Draw a schematic diagram of a circuit containing a power supply, a rheostat and a load. The Rheostat must be connected so that it controls the current through the load.
9	Given 20 resistors, the learner will use the color code to identify resistor values and determine tolerance range. Criterion of success shall be completion of the associated criterion measure at 80% accuracy.	8.9	Given 20 composition resistors of various values, use the color code to identify the resistor value and the tolerance range of each resistor.
10	The learner will state Ohm's Law and write the equations which represent the three forms of ohm's law.	8.10	(a) Write the statement of Ohm's Law.
11	Given electrical units of measurement the learner will convert the common prefixes used with electrical units of measurement from one value to another with 75% accuracy.	8.11	a. 3 amps equals _____ ma. b. .01 ua equals _____ ma. c. .5 kw equals _____ watts d. 20 K ohms equals _____ M ohms
12	Given a variety of circuit problems involving Series, Parallel and Series-parallel circuits, the learner will solve 24 of 30 problems for the unknown values.	8.12	See Attached Test.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 8.0 Resistance, Ohm's Law & Circuits

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.13	The learner will state Kirchott's laws for current and voltage.	8.13	(a) Write the statement for Kirchott's law for voltage. (b) Write the statement for Kirchott's law for current.
14	Given 10 circuit problems involving Series and Parallel combinations, the learner will use Kirchott's Laws to solve 8 for unknown values.	8.14	See Attached Test.
.15	Given 10 problems involving Bridge circuits and Voltage dividers, the learner will solve 8 of them for the unknown values.	8.15	See Attached Test.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 9.0 Hand Tools & Soldering

The learner will identify 80% of a given list of tools, will describe safety precautions for 5 given tools, will answer given questions about soldering and flux, will list the steps involved in soldering an electrical connection and will correctly solder an electrical connection.

INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
Given pictures of the common hand tools used in the Radio & T. V. Service industry the learner will identify 80% of them in writing.	9.1	Identify in writing the hand tools on the test sheet provided you. (See attached test)
Given the names of 5 common hand tools the learner will describe in writing the safety precautions to be observed with each one. 80% accuracy required: a. soldering gun b. file c. cold chisel d. screwdriver e. adjustable end wrench	9.2	State, in writing, the safety precautions to be observed while using each of the following tools: a. soldering gun b. file c. cold chisel d. screwdriver e. adjustable end wrench
Given 3 questions about soldering the learner will correctly answer all 3.	9.3	Complete the following: a. The two base metals in solder are _____ and _____. b. The type of flux used for electronic work is _____. c. The type of solder most commonly used for electronic work is _____.
The learner will state in writing the reason for using flux in soldering work.	9.4	Explain why flux is used in soldering work.
The learner will list the steps, in order, involved in soldering electrical connections.	9.5	List the proper steps in order, involved in soldering electrical connections.
Given the proper tools and supplies the learner will solder an electrical connection to the following standards: a. mechanically secure b. correct flux used c. connection completely covered with solder d. not a cold soldered connection.	9.6	Solder an electrical connection to standards shown below: a. mechanically secure b. correct flux used c. completely covered with solder d. not cold soldered

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 10.0 Electronic Diagrams

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
10.1	Given the names of 4 electronic diagrams, the learner will describe each and state the purpose of each.	10.1	Describe each of the following types of electronic diagrams and state the purpose of each: a. wiring diagram b. block diagram c. schematic diagram d. isometric diagram
10.2	Given a circuit wiring diagram, the learner will at 80% accuracy trace the circuit on the diagram and answer given questions regarding circuit tracing.	10.2	See Attached Test Sheet
10.3	Given a complex schematic diagram containing several independent circuits the learner will isolate and draw one of the circuits with 80% accuracy.	10.3	See Attached Diagram

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 11.0

Meters

Given types of meter movements, the learner will describe and compare the types of meter movements, solve problems related to internal meter circuits and define terms related to meters and describe linear and non-linear scales. The criterion of success shall be accomplishment of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
11.1	Given 5 types of meter movements, the learner will identify the types of meter movements and describe the principle of operation used in each. a. the moving-coil b. the moving-iron c. the concentric-vane d. the moving-plunger e. the hot-wire	11.1	Describe the principle of operation for each of the following types of meter movements. a. the moving-coil b. the moving-iron c. the concentric-vane d. the moving-plunger e. the hot-wire
11.2	Given a picture of a typical meter movement, the learner will identify 7 of 9 of the following meter parts which are common to most meter movements. a. coil b. pointer c. scale d. pivots e. bearings f. springs g. retaining pins h. zero-adjust screw i. damping mechanism	11.2	On the picture of a typical meter movement provided, identify the following parts. a. coil b. pointer c. scale d. pivots e. bearings f. springs g. retaining pins h. zero-adjust screw i. damping mechanism
11.3	Given the necessary information about a specific meter movement, the learner will calculate the value of shunt resistance required to cause the meter to read a specified value of current.	11.3	With a 50 microampere meter movement with a resistance of 100 ohms, what value of shunt is needed to extend the meter range to 100 milliamperes?
11.4	Given the necessary information about a specific meter movement, the learner will calculate the value of multiplier resistance required to cause the meter to read a specified value of voltage.	11.4	With a 10 milliampere meter movement with a resistance of 1000 ohms, what value of multiplier resistor is needed to measure 0-25 v.
11.5	Given the necessary information about a specific meter movement and power supply, the learner will calculate the resistance values needed to use the meter as a series Ohmmeter.	11.5	

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 11.0

Meters

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
11.6	Given the following list of terms related to meters, the learner will define 11 of 14. a. Sensitivity b. Galvanometer c. Linear scale d. Non-Linear scale e. Damping f. Calibration g. Shunt h. Multiplier i. Multirange meter j. Clamp-on ammeter k. Megger l. Wattmeter m. Circuit loading n. Rectifier	11.6	Define each of the following terms: a. Sensitivity b. Galvanometer c. Linear scale d. Non-Linear scale e. Damping f. Calibration g. Shunt h. Multiplier i. Multirange meter j. Clamp-on ammeter k. Megger l. Wattmeter m. Circuit loading n. Rectifier
11.7	The learner will describe the method used to enable a moving coil meter to measure alternating current.	11.7	Describe the components and the circuit used to enable the moving coil meter to measure alternating current.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 12.0 — A.C., Inductors, Transformers

The learner will define given AC, Inductance and transformer terms will draw given symbols, work transformer problems and build and analyze a transformer circuit. The criterion of success will be accomplishment of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
12.1	Given a list of 20 terms associated with alternating current, the learner will define them with 80% accuracy. 1. Fluctuating DC 2. Alternating Current 3. Sine Wave 4. Square Wave 5. Saw Tooth Wave 6. AC Component 7. DC Component 8. DC Reference 9. Cycle 10. Hertz 11. Wave Length 12. Phase 13. Alternation 14. Period 15. Peak 16. Instantaneous 17. Average 18. Effective 19. Eddy Currents 20. Skin Effect	12.1	Define the following terms: 1. Fluctuating DC 2. Alternating Current 3. Sine Wave 4. Square Wave 5. Saw Tooth Wave 6. AC Component 7. DC Component 8. DC Reference 9. Cycle 10. Hertz 11. Wave Length 12. Phase 13. Alternation 14. Period 15. Peak 16. Instantaneous 17. Average 18. Effective 19. Eddy Currents 20. Skin Effect
12.2	Given the peak value of an AC sine wave, the learner will calculate the effective, average, and peak-to-peak values.	12.2	An AC sine wave has a peak value of 100 volts. Calculate the following: a. effective voltage b. average voltage c. peak-to-peak volts
12.3	Given an AC circuit problem involving only resistance, the learner will use Ohm's Law to solve for unknowns.	12.3	An AC circuit has 141 volts (peak) applied and two 25 ohm resistors connected in series. a. What is the effective current flow? b. What is the average voltage drop across one of the resistors?

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 12.0 A. C., Inductors, Transformers

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
12.4	The learner will define the term "inductance" and will describe the effect that inductance has upon an AC circuit.	12.4	a. What is inductance? b. What happens to the voltage and current phase relationships when inductance is introduced into an A. C. circuit.
12.5	The student will draw the symbols for air-core and iron-core inductors and describe each in writing.	12.5	a. Draw the symbol for an air-core inductor and describe it's construction. b. Draw the symbol for an iron-core inductor and describe its construction.
12.6	The learner will state the unit of measurement for inductance and will list the factors which effect inductance.	12.6	a. Inductance is measured in _____. b. List the factors which effect inductance.
12.7	Given 16 terms associated with transformers, the learner will define 12 of them: a. mutual induction b. transformer c. primary d. secondary e. step-up f. step-down g. turns ration h. reflected impedance i. phasing dots j. power transformer k. hysteresis l. copper loss m. saturation n. auto transformer o. laminated core p. coefficient of coupling	12.7	Define the following terms: a. mutual induction b. transformer c. primary d. secondary e. step-up f. step-down g. turns ratio h. reflected impedance i. phasing dots j. power transformer k. hysteresis l. copper loss m. saturation n. auto transformer o. laminated core p. coefficient of coupling

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 12.0 A. C., Inductors, Transformers

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
2.8	The learner will draw the symbols and describe the construction of: a. air-core transformer b. iron-core transformer	12.8	a. Draw the symbol for an air-core transformer and describe its construction. b. Draw the symbol for an iron-core transformer and describe its construction.
2.9	Given 5 problems in transformer turns ratio vs. voltage and current the learner will correctly solve 4 of them.	12.9	
.0	Given the necessary materials the learner will construct a transformer circuit, analyze the circuit and state the input and output voltage, current and phase relationships.	12.10	Construct a transformer circuit and state the following: a. input voltage b. output voltage c. input current d. output current e. power in vs. power out f. phase relationship between input and output.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 13.0 Capacitance

The learner will define given terms about capacitance, will draw symbols and explain construction of capacitors, will list factors effecting capacitance and will work given capacitance problems. The criterion of success will be the completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
13.1	The learner will define the term "capacitance" and will describe the effect that capacitance has upon an AC circuit.	13.1	a. What is capacitance? b. What happens to the voltage What happens to the voltage and current phase relationships when capacitance is introduced into an A. C. circuit?
13.2	Given 14 terms associated with capacitance the learner will define 11 of them: a. plate b. dielectric c. electrostatic field d. charge e. negative plate f. positive plate g. dielectric constant h. farad i. microfarad j. picofarad k. electrolytic 1. polarity m. disc n. tubular	13.2	Define the following terms: a. plate b. dielectric c. electrostatic field d. charge e. negative plate f. positive plate g. dielectric constant h. farad i. microfarad j. picofarad k. electrolytic 1. polarity m. disc n. tubular
13.3	The learner will draw the symbols for and will describe each of the following: a. fixed capacitor b. variable capacitor	13.3	a. Draw the symbol for a fixed capacitor and describe its construction. b. Draw the symbol for a variable capacitor and describe its construction.
13.4	The learner will list the factors which effect capacitance.	13.4	List the factors which effect capacitance.
13.5	Given 5 problems involving capacitors connected in series and parallel, the learner will solve 4 of them.	13.5	

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 14.0

Mathematics for AC Circuits

The learner will transpose algebraic equations, use algebraic equations to solve for unknown values, demonstrate ability to use angular measurement, define a vector, demonstrate ability to solve right triangle problems using Pythagorean theorem, and demonstrate the ability to use triangle problems. The criterion of success will be the completion of each I.P.O. at its respective criterion.

	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.1	Given al algebraic equation, the learner will, for 2 of 3 problems, transpose the equation to solve for each in terms of the remaining factor.	14.1	In the equation: $X_C = \frac{1}{2\pi fC}$ a. What is "f" equal to ? b. What is "C" equal to?
.2	Given an equation, the learner will solve for any unknown quantity in that equation.	14.2	$X_L = 2\pi fL$ X_L = 1000 ohms f = 456 KHz L L = _____
.3	Given a written examination concerning angular measurement, the learner will complete the questions regarding the use of angular measurement.	14.3	a. How many degrees are there in a circle? b. How many degrees are there in a right angle? c. If you were traveling north and made a 270 degree turn to the left followed by a 90 degree turn to the right, which direction would you be traveling?
.4	The learner will define a vector?	14.4	Define a vector?
.5	The learner will define and label a right triangle.	14.5	a. Define a right triangle. b. Draw a right triangle and label all sides and angles.
.6	Given a right triangle with one unknown side, the learner will use the pythagorean theorem to determine the length of the unknown side.	14.6	A right triangle has a base of 30 feet and an altitude of 40 feet. What is the length of the hypotenuse?

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 14.0 Mathematics for AC Circuits

O.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
.7	Given a right triangle with only one side and one angle known, the learner will use trigonometric function to solve for the remaining sides and angle.	14.7	A right triangle has an angle the opposite side equals 24 inches. Solve for the following: Adjacent side _____ Hypotenuse _____ Angle _____

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 15.0 Inductive Reactance and Impedance

The learner will define given terms, calculate given inductive reactance and impedance problems and will construct and analyze given series and parallel RL circuits. The criterion of success will be completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
15.1	Given a list of 10 terms associated with Inductive Reactance, Impedance, and RL circuits the learner will define 8 of them: a. inductive reactance b. RL circuits c. impedance d. true power e. apparent power f. power factor g. RL time constant h. "Q" of a coil i. Z j. frequency response	15.1	Define the following terms: a. inductive reactance b. RL circuit' c. impedance d. true power e. apparent power f. power factor g. RL time constant h. "Q" of a coil i. Z j. frequency response
15.2	Given the value of a coil and the frequency of the circuit, the learner will use the correct formula to determine the inductive reactance.	15.2	What is the inductive reactance of a one Henry coil when used with a frequency of 100 Hz?
15.3	The learner will explain the relationship between frequency and inductive reactance.	15.3	Explain the following relationships: (a) If the frequency if increased, what happens to the inductive reactance? (b) If the frequency is decreased, what happens to the inductance?
15.4	Given a Series RL circuits problem the learner will analyze the operation of the circuit, calculate all pertinent data and determine the effect of a change in frequency upon the circuit. The criterion of success will be completion of 10 of the 14 parts of the criterion measure.	15.4	(A) A 10 Henry coil and a 1000 ohm resistor are connected in series across a 200 volt, 50 Hz power supply. Calcualte the following: (a) I_{total} (b) E_R (c) E_L (d) X_L (e) Z (f) PF (g) Phase angle

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 15.0

Inductive Reactance and Impedance

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
15.5	Given a parallel RL circuit problem with 14 parts the learner will correctly solve 10 of the parts.	15.5	(A) A 100 ohm resistor is connected in parallel with a 10 Henry coil across a 100 volt, 60 Hz. power supply. Find the following: a. I total b. I_T c. I_L d. X_L e. Z f. PF g. Phase angle (B) If the frequency in the above circuit is decreased to 30 Hz solve for the same factor as above.
15.6	Given the values of a resistance and inductance in a circuit, the learner will determine the RL time constant for that circuit, and calculate the rise of maximum current in the circuit.	15.6	A 2 heavy inductor is connected in series with a 10 ohm resistor. What is the RL time constant and how long will it take the current in this circuit to rise maximum?
15.7	Given the necessary job sheet, material and test equipment the learner will construct a Series RL circuit and a parallel RL circuit and use the test equipment to analyze the circuit and will verify all calculated values at 80% accuracy.	15.7	Construct a Series and a parallel RL circuit according to the job sheet given you by the instructor. Calculate and verify all pertinent data about the operation of each circuit.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 Capacitive Reactance and Impedance

The learner will define given terms associated with Capacitive Reactance and Impedance, will solve given problems, state relationships and will construct and analyze given RC circuits. The criterion of success will be the completion of each I.P.O. at its respective criterion.

INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
Given 5 terms associated with Capacitive Reactance and RC circuits the learner will define 4 of them.	16.1	Define: a. Capacitive Reactance b. X_C c. Z in RC circuits d. RC circuit e. RC time constant
Given the value of a Capacitor and the frequency of the circuit, the learner will write the correct formula for Capacitive Reactance and use the formula to determine the Capacitive Reactance of the Capacitor.	16.2	If a 1 ufd. capacitor is connected in a circuit with a frequency of 1000 Hz., the capacitive reactance could be determined by using the formula: X_C = ? and would be _____ ohms.
The learner will state the relationship between frequency and Capacitive Reactance.	16.3	Explain: (A) If the frequency in a circuit is increased, what happens to the capacitive reactance? (B) If the frequency is decreased, what happens to the capacitance?
Given the values of components in a series RC circuit the learner will solve 5 of 6 given calculations about the circuit.	16.4	A 100 ohm resistor is connected in series with a 20 ufd. capacitor. There is ½ amp. flowing through them and 75 volts dropped across the capacitor. Calculate the following: a. applied voltage b. E_R c. Z d. phase angle e. frequency f. power factor

COURSE TITLE: Electronics Technology

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 Capacitive Reactance and Impedance

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
16.5	Given the values of components in a parallel will solve 5 of 6 given calculations about the circuit.	16.5	A 1000 ohm resistor is connected in parallel with a 2 ufd. Capacitor and the combination is connected to a 110 volt, 60 Hz. power source. Calculate the following: a. line current b. X_C c. Z d. I_R e. I_C f. Phase angle g. power factor
16.6	Given the values of resistance and capacitance in a circuit, the learner will calculate the RC time constant for that circuit.	16.6	A 1 Megohm resistor is connected in series with a 1 ufd. capacitor. What is the RC time constant for this circuit?
16.7	Given the necessary material and equipment and a job sheet the learner will construct a series RC circuit and a parallel RC circuit. He will use the test equipment to analyze the circuits to verify all calculated values.	16.7	Construct a series and a parallel RC circuit according to the job sheet provided you by the instructor. Calculate all given problems about the circuits and then use the test equipment to verify all calculated data.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 17.0 AC Circuit Analysis

Given both series or parallel RLC circuit combination, the learner will calculate the voltage, current, impedance, power and phase relationships describe the results of frequency changes upon each of these quantities. The criterion of success shall be completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
17.1	Given a circuit with a resistor, a capacitor and an inductor connected in series, the learner will calculate the voltage, current, impedance, power and phase relationships. Criterion of success shall be completion of 7 of 9 parts of the associated criterion measure.	17.1	A 50 ohm resistor, an Inductive reactance of 180 ohms and a capacitive reactance of 150 ohms are connected in series to a 110 volt power source. Calculate the following: a. I b. E_{XC} c. E_{XL} d. E_R e. Phase Angle f. Power Factor g. True power h. Apparent power u. Put (Inc.) or (Dec) or (**) bt each of the values to indicate what would happen to that quantity if the frequency were increased.
17.2	Given a circuit with a resistor, a capacitor and an inductor connected in parallel, the learner will calculate the voltage, current, impedance, power and phase relationships. Criterion of success shall be completion of 9 of 11 parts of' the criterion measure.	17.2	A 25 ohm resistor, a 33 ufd. capacitor and a 30 mh coil are connected in parallel across a 100 volt, 100Hz power source. Calculate the following: a. X_L b. X_C c. I_t d. I_R e. I_C f. I_I g. Phase angle h. Power factor i. True power j. Apparent power k. Indicate what would happen to each of these value if the frequency is increased.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 18.0 Series Resonant Circuit

Given examples of resonant circuits the material and equipment, the learner will define terms associated with series resonant circuits, list the factors which determine resonance, write and use the resonant frequency formula, calculate impedance, voltage, current power and phase relationships in series resonant circuits, describe the effect of resistance in series resonant circuits. describe applications for series resonant, and construct and and analyse a series resonant circuit. The criterion of success will be

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
18.1	The learner will define 7 of 9 terms associated with series resonant circuits. a. Resonance b. Resonance frequency c. High Q d. Low Q e. Narrow band-pass f. Wide band-pass g. frequency filter h. trap i. response curve	18.1	Correctly define the following: a. Resonance b. Resonance frequency c. High Q d. Low Q e. Narrow band-pass f. Wide band-pass g. frequency filter h. trap i. response curve
18.2	The learner will list the 3 factors which determine resonance. a. Frequency b. inductance c. capacitance	18.2	List the 3 factors which determine resonance.
18.3	Given the value for a capacitor and an inductor, the learner will write the formula for resonant frequency and use the formula to calculate the resonant frequency for given components.	18.3	a. Write the formula for resonant frequency. b. What is the resonant frequency for a capacitor of 4 ufd. and a 1 henry inductor?
18.4	Given a series resonant circuit, the learner will calculate the voltage, current, impedance, power, and phase relationships along with Q and bandwidth. The criterion of success will be completion of 9 of 11 parts of the criterion measure.	18.4	A 10 ohm resistor, 5 millihenry coil and a .01 ufd. capacitor are connected in series across a 100 volt source that is operating at the resonant frequency. Calculate the following: a. Res. Frequency b. X_L c. X_C d. Z e. I f. E_R g. E_{XL} h. E_{XC} i. pf j. Q k. B-width

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 18.0 Series Resonant Circuit

completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
18.5	The learner will describe circuit characteristics for a series resonant circuit what that circuit is above resonance, at resonance and below resonance.	18.5	What are the characteristics of a series resonant circuit. a. above resonance b. at resonance c. below resonance
18.6	The learner will describe the effects of resistance in a series resonant circuit. As if affects the following: a. resonant frequency b. total current c. bandwidth d. Q e. power factor	18.6	If resistance is increased in a series resonant circuit, what will be the effect on each of the following? a. resonant frequency b. total current c. bandwidth d. Q e. power factor
18.7	The learner will list and describe two applications for a series resonant circuit.	18.7	Name two applications for a series resonant circuit and describe the operation of each.
.8	Given the necessary materials and test equipment, the learner will construct a series resonant circuit, and calculate impedance, voltage, and current and use test equipment to verify calculations 80% accuracy is required.	18.8	Construct a series resonant circuit according to job plan given you by the instructor. Calculate the impedance, voltage, current and resonant frequency. Use test equipment you verify calculations.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 19.0

Parallel Resonant Circuits

Given examples of parallel resonant circuits, the equipment and materials, the learner will define terms associated with parallel resonant circuits, calculate impedance, voltage, current, Q and bandwidth of a parallel resonant circuit, describe the effect of resistance in parallel resonant circuits, describe applications for parallel resonant circuits and construct and analyze a parallel resonant circuit. The criterion of success will be completion of each I.P.O. at its respective criterion.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
19.1	The learner will define 5 of 7 terms associated with parallel resonant circuits.	19.1	Define the following terms: a. parallel resonance b. tank circuit c. circulating current d. damped wave e. infinite impedance f. Q in parallel resonance g. band reject
19.2	Given a parallel resonant circuit the learner will calculate the voltage, current, impedance, "Q" and Bandwidth of the circuit. Criterion of success will be completion of 6 of the 8 parts of the criterion measure.	19.2	A 6.4 millihenry coil with 5 ohms resistance is connected in parallel with a ufd. capacitor across a 200 volt power supply operating at the resonant frequency. Calculate the following: a. Resonant Frequency b. X_L c. X_C d. I_L e. I_C f. Z g. Q h. Bandwidth
19.3	The learner will describe the circuit characteristics for a parallel resonant circuit when that circuit is above resonance, at resonance and below resonance.	19.3	What are the characteristics of a parallel resonant circuit? a. above resonance b. at resonance c. below resonance
19.4	The learner will describe the effects of resistance in a parallel resonant circuit as it affects the following. a. resonant frequency b. total current c. bandwidth d. Q e. power factor	19.4	If the amount of resistance in a parallel resonant circuit, what will be the effect on each of the following: a. resonant frequency b. total current c. bandwidth d. Q e. power factor

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 19.0 Parallel Resonant Circuits

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
19.5	The learner will list and describe two applications for a parallel resonant circuit.	19.5	Name two applications for a parallel resonant circuit and describe the operation of each.
19.6	Given the necessary materials and test equipment, the learner will construct a parallel resonant circuit, calculate impedance, voltage, and current, and use test equipment to verify calculations. 80% accuracy is required.	19.6	Construct a parallel resonant circuit according to job plan given you by the instructor. Calculate the impedance, voltage, current and resonant frequency. Use the test equipment to verify calculations.

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COURSE TITLE: Electronics Technology - Basic

TERMINAL PERFORMANCE OBJECTIVE NO. 20.0

Electronics Technician Occupation Analysis

The learner will with not less than 75% proficiency list and describe occupations related to the Electronics Technology fields, demonstrate knowledge of the variety of employment opportunities in the Greater Jacksonville Community. Identify the professional organizations and publications, demonstrate knowledge of the awareness of the licensing processes and the need for continuing post high school education.

NO.	INTERMEDIATE PERFORMANCE OBJECTIVES	NO.	CRITERION MEASURES
20.1	The learner will with not less than 75% accuracy demonstrate knowledge of the occupations that require training in the Electronics Technology field.	20.1	List eight (8) types of industry that employ electronics technicians. a. Radio & T. V. Series b. manufacturer of electronics equipment c. aeronautical industry d. space industry e. medical industry f. nautical industry g. miliatary organizations h. government agencies
20.2	The learner will with not less than 75% accuracy demonstrate knowledge of the salary schedules, and types of occupations related to Electronics Technology.	20.2	List three (3) occupations and their salary schedules as they relate to the Electronics industry.
20.3	The learner will with not less than 75% accuracy demonstrate knowledge of the industries in the Jacksonville area that employee Electronics Technicians.	20.3	List four (4) Jacksonville based industries that employ Electronics Technicians. a. IBM b. Southern Bell Telephone c. Jax Naval Air Station d. Federal Aviation Authority
20.4	The learner will with not less than 75% accuracy demonstrate knowledge of the publications devoted to the Electronics Technology.	20.4	List two (2) publications devoted to the Electronics Technician and Technology. a. Electronics Today b. Electronics Digest
20.5	The learner will with not less than 75% accuracy demonstrate knowledge of the requirements to secure FCC licensing.	20.5	Define the process used to secure the FCC licensing for the Radio Operators Technician.
20.6	The learner will with not less than 75% accuracy demonstrate knowledge of continuing education in Electronics Technology	20.6	Name three (3) ways to continue ones education in the Electronics Technology.